

CLAIMS

I/We claim:

- [c1] 1. An apparatus for handling microelectronic workpiece containers, comprising:
- a container support having at least one support element positioned to carry a microelectronic workpiece container; and
- a container securement device positioned at least proximate to the at least one support element, the container securement device having at least one contact surface, the at least one contact surface being movable relative to the at least one support element in a first direction between a first position and a second position, with the contact surface contacting or positioned to contact a surface of the microelectronic workpiece container when in the second position, the contact surface further being movable in a second direction from the second position to a third position with the contact surface clamping the microelectronic workpiece container against the at least one support element, wherein the second direction is different than the first direction.
- [c2] 2. The apparatus of claim 1 wherein the at least one contact surface is one of at least two contact surfaces, and wherein the container securement device includes first and second grip members, each having one of the contact surfaces, each grip member being pivotable to move one of the contact surfaces between the first position and the second position.
- [c3] 3. The apparatus of claim 1 wherein the surface of the microelectronic workpiece container bounds an aperture of the microelectronic workpiece

container, and wherein the at least one contact surface is positioned to be received in the aperture when in the first position.

[c4] 4. The apparatus of claim 1 wherein the at least one contact surface is pivotable in the first direction between the first position and the second position, and wherein the at least one contact surface is movable along a generally linear axis from the second position to the third position.

[c5] 5. The apparatus of claim 1 wherein the securement device is configured to move the at least one contact surface in the first direction without moving the at least one contact surface in the second direction.

[c6] 6. The apparatus of claim 1 wherein the securement device is configured to move the at least one contact surface in the second direction without moving the at least one contact surface in the first direction.

[c7] 7. The apparatus of claim 1 wherein the securement device includes:
a base;
a grip member support;
a linear actuator coupled between the base and the grip member support;
at least one spring coupled between the base and the grip member support
to force the grip member support away from the base;
first and second grip members pivotably coupled to the grip member support, each grip member having an outwardly extending contact portion, each contact portion being pivotable between the first position and the second position; and
a linkage coupled between the grip members and the linear actuator;
wherein axial motion of the linear actuator between a first actuator position and a second actuator position pivots the first and second grip members; and wherein

axial motion of the actuator between the second actuator position and a third actuator position moves the first and second grip members and the grip member support axially toward the base.

[c8] 8. The apparatus of claim 1, further comprising:
a plurality of processing stations positioned at least proximate to the container support; and
a transfer device positioned to move microelectronic workpieces between the containers and the processing stations.

[c9] 9. The apparatus of claim 1 wherein the securement device includes:
a grip member support;
first and second grip members pivotably coupled to the grip member support, the first and second grip members each having a prong with an outwardly extending contact portion, the contact portions of each of the first and second grip members being pivotable between the first position and the second position; and
a third grip member pivotably coupled to the grip member support, the third grip member having a prong with an outwardly extending contact portion, the contact portion of the third grip member being pivotable between the first position and the second position, at least a portion of the prong of the third grip member being received between the prongs of the first and second grip members when the contact portions are in the first positions.

[c10] 10. The apparatus of claim 1, further comprising a sensor positioned at least proximate to the securement device to detect motion of at least a portion of the securement device in at least one of the first and second directions.

[c11] 11. The apparatus of claim 1 wherein the at least one contact surface is carried by a grip member pivotably coupled to a grip member support, and wherein the apparatus further comprises a linear actuator coupled to both the grip member and the grip member support, and wherein linear motion of the actuator over a first range pivots the at least one contact surface, and wherein linear motion of the actuator over a second range moves the contact surface along a generally linear path.

[c12] 12. An apparatus for handling microelectronic workpiece containers, comprising:

container support means for carrying a microelectronic workpiece container; and

container securement means for releasably securing a microelectronic workpiece container to the container support means, the container securement means having at least one contact surface, the at least one contact surface being movable relative to the container support means in a first direction between a first position and a second position, with the contact surface contacting or positioned to contact a surface of the microelectronic workpiece container when in the second position, the contact surface further being movable in a second direction from the second position to a third position with the contact surface clamping the microelectronic workpiece container against the container support means, wherein the second direction is different than the first direction.

[c13] 13. The apparatus of claim 12 wherein the container securement means includes first and second grip members, each grip member having a contact surface, and wherein the contact surfaces are pivotable between the first and second positions.

[c14] 14. The apparatus of claim 12 wherein the container securement means includes first and second grip members, each grip member having a contact surface, and wherein the contact surfaces are movable along generally linear paths between the second and third positions.

[c15] 15. A method for manufacturing an apparatus for handling microelectronic workpiece containers, comprising:

providing a container support having at least one support element positioned to carry a microelectronic workpiece container; and positioning a container securement device at least proximate to the at least one support element, the container securement device having at least one contact surface, the at least one contact surface being movable relative to the at least one support element in a first direction between a first position and a second position, with the contact surface contacting or positioned to contact a surface of the microelectronic workpiece container when in the second position, the contact surface further being movable in a second direction from the second position to a third position with the contact surface clamping the microelectronic workpiece container against the at least one support element, wherein the second direction is different than the first direction.

[c16] 16. The method of claim 15, further comprising:
pivotably coupling a plurality of grip members to a grip member support, with each grip member having a contact surface that is pivotable between the first and second positions; and
coupling a linear actuator to the grip member support.

[c17] 17. The method of claim 15, further comprising pivotably coupling a plurality of grip members to a grip member support, with each grip member having a contact surface that is movable between the first and second positions.

[c18] 18. The method of claim 15 wherein positioning a container securement device includes positioning a container securement device having the at least one contact surface being pivotable in the first direction between the first position and the second position, and wherein the at least one contact surface is movable along a generally linear axis from the second position to the third position.

[c19] 19. The method of claim 15, further comprising:
coupling a linear actuator between a base and a grip member support;
positioning at least one spring between the base and the grip member support to force the grip member support away from the base;
pivotably coupling first and second grip members to the grip member support, each grip member having an outwardly extending contact portion, each contact portion being pivotable between the first position and the second position; and
coupling a linkage between the grip members and the linear actuator;
wherein axial motion of the linear actuator between a first actuator position and a second actuator position pivots the first and second grip members; and wherein
axial motion of the actuator between the second actuator position and a third actuator position moves the first and second grip members and the grip member support axially toward the base.

[c20] 20. The method of claim 15, further comprising:
positioning a plurality of processing stations at least proximate to the container support; and

disposing a transfer device between at least one of the processing stations and the container support, the transfer device being configured to move microelectronic workpieces between the container support and the at least one processing station.

[c21]

21. The method of claim 15, further comprising:

pivotably coupling first and second grip members to a grip member support, the first and second grip members each having a prong with an outwardly extending contact portion, the contact portions of each of the first and second grip members being pivotable between the first position and the second position; and

pivotably coupling a third grip member to the grip member support, the third grip member having a prong with an outwardly extending contact portion, the contact portion of the third grip member being pivotable between the first position and the second position, at least a portion of the prong of the third grip member being received between the prongs of the first and second grip members when the contact portions are in the first positions.

[c22]

22. The method of claim 15, further comprising disposing a sensor at least proximate to the securement device to detect motion of at least a portion of the securement device in at least one of the first and second directions.

[c23]

23. The method of claim 15, wherein the at least one contact surface is carried by a grip member pivotably coupled to a grip member support, and wherein the method further comprises coupling a linear actuator to both the grip member and the grip member support, and wherein linear motion of the actuator over a first range pivots the at least one contact surface, and wherein linear motion of the actuator over a second range moves the contact surface along a generally linear path.

[c24] 24. A method for securing a microelectronic workpiece container to a container support, comprising:

contacting the microelectronic workpiece container with a support element of the container support;

moving at least one contact surface of a securement device from a first position to a second position with the at least one contact surface contacting or positioned to contact a surface of the microelectronic workpiece container when in the second position; and

drawing the microelectronic workpiece container toward the support element with a second motion of the at least one contact surface in a second direction different than the first direction.

[c25] 25. The method of claim 24 wherein moving the at least one contact surface in a first direction includes pivoting the at least one contact surface.

[c26] 26. The method of claim 24 wherein moving the at least one contact surface in the second direction includes moving the at least one contact surface in a generally linear direction.

[c27] 27. The method of claim 24 wherein the at least one contact surface is one of at least two contact surfaces, and wherein moving at least one contact surface includes pivoting a first contact surface in a first direction and pivoting a second contact surface in a second direction opposite the first direction.

[c28] 28. The method of claim 24, further comprising moving the at least one contact surface to the first position, with the at least one contact surface located within an aperture of the microelectronic workpiece container when in the first position.

[c29]

29. The method of claim 24, further comprising:
supporting a grip member support relative to a base;
forcing the grip member support away from the base with a spring;
pivoting first and second grip members relative to the grip member support
between a first position and a second position to contact outwardly
extending contact portions of each grip member with the
microelectronic workpiece container, by moving an actuator coupled
to the grip members between a first actuator position and a second
actuator position; and
moving the actuator from the second actuator position to a third actuator
position to move the first and second grip members and the grip
member platform axially toward the base and clamp the
microelectronic workpiece container.